

BISC 300--Fall 2002)
Introduction & Chapter 1 Notes
Evolution, Microbial Life, and the Biosphere

I. Prokaryotes on Earth

A. How many?

Compare to number of people:

USC Student Population:	15,000	1.5×10^3
California Population (2001):	35,000,000	3.5×10^7
United States Population (2001):	290,000,000	2.9×10^8
World Population:	6,200,000,000	6.2×10^9
World Prokaryotic Population:	5,000,000,000,000,000,000,000,000,000	5.0×10^{30}

This equals 50% of the world's bioavailable CARBON. Same amount of carbon as in plants.
 10 times the as much bioavailable nitrogen and phosphorus as plants.

B. Where do they live?

Different environments of prokaryotes:

On Humans: Skin: 10^3 - 10^4 cells/cm ² , groin & axilla 10^6 /cm ² = 3.0×10^8	
Colon: 3.2×10^{11} /g	7.0×10^{13} total
Air: Detected as high as 57-77 km (34-46 mi) high, clouds =	5.0×10^{19} cells
Animals: Humans (4×10^{23} cells), Domestic animals, Termites =	5.0×10^{24} cells
Soils: Forests, Grassland, Desert, Tundra, Swamps =	2.5×10^{29} cells
Aquatic: Marine and Freshwater 10^4-10^7 cells/ml =	1.0×10^{29} cells
Subsurface: Terrestrial and Deep Ocean (0.1 - 3000 meters) =	3.8×10^{30} cells

C. How can you get so many:

For a bacterium with a 20 minute doubling (generation) time growing for 2 days with unlimited food supply:

Mass of one bacterium:	9.5×10^{-13} g
48 hours = 144 generations = 2^{144} new cells	2.2×10^{43} cells
Mass of those cells	2.1×10^{31} g
Mass of the earth:	6×10^{27} g

Therefore after 48 hours, weight of bacteria would equal: **3500 earths**

Mass of sun = **2×10^{33} g** Mass of earth = **6×10^{27} g**

CHAPTER 1 Evolution, Microbial Life, and the Biosphere

Without microbes none of us would be here.

Page 3 ORIGIN OF EARTH AND LIFE

Table 1.1-Geological Time Table on Earth

Page 4 Fossil evidence of microorganisms

Fig. 1.1 Stromatolites and mat communities

Fig. 1.2 Shark Bay stromatolites

Fig. 1.3 Mat communities

Page 5 Origin of Life on Earth

Miller expts: Fig. 1.4: CH₃, H₂, NH₃, spark

Current models say early earth atmosphere = CO₂, N₂, SO₂, H₂S, UV light, volcanoes

Page 8 TRACING BIOLOGICAL EVOLUTION

Page 9 Cell theory: A definition of Life

Fig. 1.5 Cell structure

Page 9 The Tree of life

Fig. 1.6 Tree of life...three domains (PROK vs. EUK)

Page 10 PROKARYOTES VS. EUKARYOTES

Table 1.2/OH-Table of differences, BACT, ARCH, EUK

Page 12 Morphological differences.

Page 14 Reproductive differences

Fig. 1.13 Binary Fission

Page 14 Cell size: Volume vs. Surface

Fig. 1.15 Compare surface and volume.

Page 16 Microbial nutrition--Source of ENERGY and CARBON--organic vs. inorganic

Table 1.4 Nutritional Types-Autotrophic (Photoautotrophs) vs. Chemotrophic (Heterotrophics/Organotrophic), Photoheterotrophs

Page 17 Possible early metabolism

Anoxygenic photosynthesis: (1) $\text{CO}_2 + \text{H}_2\text{S} \rightarrow (\text{CH}_2\text{O})_n + \text{S}_0$

(2) $\text{CO}_2 + \text{S}_0 \rightarrow (\text{CH}_2\text{O})_n + \text{SO}_4^{--}$

Oxygenic photosynthesis (3) $\text{CO}_2 + \text{H}_2\text{O} \rightarrow (\text{CH}_2\text{O})_n + \text{O}_2$

Page 19 EVOLUTION OF EUKARYOTES

Fig. 1.16-Lines of descent and the Endosymbiont hypothesis

Page 21 SEQUENCE OF EVENTS

Fig. 1.18 Timetable

Page 23 Astrobiology

Mars and Europa

COMPARE BACTERIA, ARCHAEA & EUKARYOTES

System	BACT	ARCH	EUK
Nucleus	-	-	+
Linear Chrom.	-	-	+
Histones	-	+	+
Introns	-	-	+
Operons	+	+	-
TATA promoter	-	+	+
70S ribosomes	+	+	-
Organelles	-	-	+
Sexual Reprod.	-	-	+